CLAIMS

What is claimed is:

1. A method for controlling a planar electric motor comprising a magnet array having a magnets with magnetic fields and a coil array comprising coils generally disposed in a plane, for positioning in six degrees of freedom, comprising:

determining currents to be applied to coils to generate forces between the magnet array and the coil array in first, second, and third directions, the first and second directions lying in the plane and being generally orthogonal to each other and the third direction being generally orthogonal to the first and second directions;

determining resultant torques about the first, second, and third directions between the magnet array and the coil array generated by the forces generated by the determined currents;

determining current adjustments to compensate for the resultant torques; and

applying a sum of the determined currents and determined current adjustments to the coils to interact with the magnetic fields of the magnet array to control the planar electric motor.

2. The method of claim 1, further comprising determining a relative position of the magnet array with respect to the coil array and using said determined position to determine said currents, said resultant torque or said current adjustments.

3. The method of claim 1, wherein the currents to be applied to coils in the portion of the coil array are sinusoidal, triangular or square waveforms.

4. The method of claim 1, further comprising determining forces generated between the magnet array and the coil array in the first, second, and third directions to result in forces in the first, second, third directions and/or about the first, second and third directions.

5. The method of claim 1, wherein the current adjustments are determined for each coil in a predetermined portion of the coil array.

6. The method of claim 1, wherein currents to be applied to the coils is determined only for coils in a predetermined portion of the coil array.

7. The method of claim 1, wherein the sum of the currents and current adjustments to the coils is applied only to coils in a predetermined portion of the coil array.

8. The method of claim 7, wherein the coils in the predetermined portion of the coil array includes coils partially within the magnetic fields of the magnet array.

9. The method of claim 1, wherein the coils in the portion of the coil array comprises twenty-five or fewer coils.

10. The method of claim 1, wherein the coils in the portion of the coil array comprises twelve or more coils.

11. The method of claim 1, wherein the coils in the portion of the coil array comprises sixteen or more coils.

12. A method for determining current to be applied to control a planar electric motor in six degrees of freedom, the motor having a magnet array and a coil array having coils generally disposed in a plane, comprising:

determining currents to be applied to coils to generate forces between the magnet array and the coil array in first, second, and third directions, the first and second directions lying in the plane and being generally orthogonal to each other and the third direction being generally orthogonal to the first and second directions, the currents being dependent upon the position of the magnet array and desired forces in the first, second, and third directions or about the first, second, and third directions;

determining resultant torques generated by the determined currents; and

determining current adjustments to be added to the determined currents to compensate for the resultant torques.

13. The method of claim 12, further comprising determining a sum of the currents and current adjustments.

14. The method of claim 12, wherein the currents are determined only for coils in a portion of the coil array within a magnetic field of the magnet array.

15. The method of claim 14, wherein the coils in the portion of the coil array include coils partially within the magnetic fields of the magnet array.

16. The method of claim 12, wherein the step of determining the currents to be applied to the coils comprises determining the currents to be applied to twenty-five or fewer coils.

17. The method of claim 12, wherein the step of determining the currents comprising determining the currents to be applied to twelve or more coils.

18. A method for positioning an object in a lithography system, comprising:

providing a frame;

providing a stage for supporting the object and movable to position the object relative to the frame in six degrees of freedom;

providing a coil array attached to the frame, the coil array having coils;

providing a magnet array adjacent a portion of the coil array, the magnet array being attached to the stage and having magnets generally disposed in a plane, the plane defining a first and second direction;

determining currents to be applied to coils in the portion of the coil array to generate forces between the magnet array and the coil array in the first, second, and third directions;

determining a resultant torque between the magnet array and the coil array generated by the forces;

determining current adjustments to compensate for the resultant torque; and

applying a sum of the determined currents and determined current adjustments to the coils to interact with magnetic fields of the magnet array.

19. The method of claim 18, further comprising determining a position of the magnet array relative to the coil array and using the position of the magnet array in determining currents, resultant torque or current adjustments.

20. The method of claim 18, wherein currents to be applied to coils in the portion of the coil array are sinusoidal, triangular or square waveforms.

21. The method of claim 18, further comprising determining forces to be generated between the magnet array and the coil array in the first, second, and third directions to result in forces in the first, second, and third directions or torques about the first, second, and third directions.

22. The method of claim 18, wherein the current adjustments are determined for each coil in the portion of the coil array.

23. The method of claim 18, wherein currents to be applied to the coils are determined only for coils in the portion of the coil array.

24. The method of claim 18, wherein the sum of the determined currents and determined current adjustments to the coils is applied only to coils in the portion of the coil array.

25. The method of claim 24, wherein the coils in the portion of the coil array include coils partially within the magnetic fields of the magnet array.

26. The method of claim 18, wherein the coils in the portion of the coil array comprise twenty-five or fewer coils.

27. The method of claim 18, wherein the coils in the portion of the coil array comprise twelve or more coils.

28. The method of claim 18, wherein the coils in the portion of the coil array comprise sixteen or more coils.

29. A method for determining current to be applied to control a planar electric motor in six degrees of freedom, the motor having a magnet array and a coil array having coils generally disposed in a plane, comprising:

determining a position of the magnet array relative to the coil array in the X, Y, and Z directions, the X and Y directions being defined by the plane and the Z direction being generally orthogonal to the X and Y directions;

determining desired forces R_x, R_y, and R_z in the X, Y, and Z directions, respectively, for independently controlling the magnet array to move relative to the coil array in the X, Y, and Z directions or about the X, Y, and Z directions;

determining currents to be applied to the coils for generating the desired forces R_x, R_y, and R_z between the magnet array and the coil array;

determining a resultant torque generated by the currents according to the position of the magnet array relative to the coil array and to the desired forces R_x, R_y, and R_z; and

determining current corrections Δ_x, Δ_y, Δ_z to be added to the currents, to produce torques T_x, T_y, T_z;

wherein resultant the forces F_x, F_y, F_z are equal to the desired forces R_x, R_y, and R_z, and the resultant torques T_x, T_y, T_z equal desired values.

30. A method for making a wafer utilizing the positioning method of claim 18.

31. A method for making a device including at least an exposure process, wherein the exposure process uses the lithography system utilizing the method of claim 18.

32. A planar motor comprising:

a first member;

a second member that interacts with the first member to generate driving force, the second member being movable relative to the first member in six degrees of freedom including a first, second, and third directions by the driving force; and

a controller connected to at least one of the first member and second member, the controller determining information related to resultant torque about the first, second and third directions between the first member and the second member generated by the driving force.

33. The planar motor of claim 32, further comprising a measuring system connected to the controller, the measuring system detecting information related to the relative position between the first member and the second member; and wherein the controller determines the resultant torque based on the information related to the relative position between the first member and the second member.

34. The planar motor of clam 32, wherein the controller determines the information that is utilized to compensate for the resultant torque.

35. The planar motor of claim 34, wherein the controller outputs the information to at least one of the first member and second member to generate force for compensation of the resultant torque.

36. The planar motor of claim 32, wherein the driving force is generated by utilizing a Lorentz force.

37. The planar motor of claim 32, wherein the first member includes a magnet array having magnets and the second member includes a coil array having coils generally disposed in a plane, the plane defining a first and second direction and the direction of the driving force is substantially the same as the first and second direction.

38. The planar motor of claim 37, wherein the controller determines current adjustment to compensate for the resultant torque.

39. A stage assembly including the planar motor of claim 32.

40. A lithography system including the stage assembly of claim 39.

41. A device manufactured with the stage assembly of claim 39.

42. A wafer on which an image has formed by the lithography system of claim 40.